

WHAT IS CLAIMED IS:

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1. A method for restoring a virtual path in an optical network, the method comprising:
 - 5 broadcasting a plurality of resource request packets to a plurality of nodes in said optical network;
 - identifying a plurality of nodes with resources wherein said nodes with resources are ones of said nodes having a resource necessary to support said virtual path;
 - 10 determining an alternate physical path, said alternate physical path comprising ones of said nodes with resources;
 - configuring said alternate physical path by establishing a communication connection between said ones of said nodes with resources; and
 - 15 restoring said virtual path by provisioning said virtual path over said alternate physical path.
2. The method of claim 1, further comprising:
 - detecting a failure in said virtual path;
3. The method of claim 2, wherein:
 - 20 said detection of said failure is done by receiving a failure message packet;
 - said identification of said nodes with resources is done by acknowledging said failure message packet; and
 - said determination of said nodes with resources is done by
 - 25 analyzing a response to said resource request packets.

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4. The method of claim 2, wherein:
 said virtual path is provisioned on a physical path between a
 first and a second node of said optical network;
 said optical network comprises said nodes; and
 each one of said nodes is coupled to at least one another of said
 nodes by a plurality of optical links.

5. The method of claim 4, wherein:
 said physical path between said first and said second node
 comprises a plurality of intermediate nodes.

6. The method of claim 4, wherein each one of said nodes is coupled to at
 least one another of said nodes in a mesh topology.

7. The method of claim 6, wherein said restoring of said virtual path is
 completed in less than 2 seconds.

8. The method of claim 6, wherein said restoring of said virtual path is
 completed in less than 250 milliseconds.

9. The method of claim 6, wherein said restoring of said virtual path is
 completed in less than 50 milliseconds.

10. The method of claim 6, wherein said restoring of said virtual path by is
 performed by said first node.

11. The method of claim 10, further comprising:
 if said failure is a local physical port failure between said first
 node and an adjacent node,
 determining an available different physical port of said
 link between said first node and said adjacent
 nodes,

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initiating a physical port switch request for said adjacent
node,
provisioning said virtual path to said different physical
port, and
5 updating said provisioning information in a node
database.

12. The method of claim 11, further comprising:
if different physical port of said link between said first node
and said adjacent nodes is unavailable,
10 (i) changing a state of said virtual path to restoring,
(ii) identifying a plurality of adjacent nodes with
required bandwidth for said virtual path,
(iii) forwarding a path restoration request to said
plurality of adjacent nodes with required bandwidth
15 for said virtual path, and
(iv) waiting for a response for said path restoration
request for a first predetermined time interval.

13. The method of claim 12, further comprising:
if said response to said path restoration request is not received
20 within said first predetermined time interval,
repeating steps (ii) – (iv) for a second predetermined
time interval.

14. The method of claim 13, further comprising:
if said response is not receive in within said second
25 predetermined time interval,
generating network alarms.

15. The method of claim 14, wherein said first and said second
predetermined time intervals are defined during provisioning of said virtual path.

16. The method of claim 14, wherein said first and said second predetermined time intervals are dynamically calculated by said network based on network traffic condition.

17. The method of claim 10, further comprising:

if said failure did not occur at a physical port of said link between said first node and one of adjacent nodes of said first node,

- (i) changing a state of said virtual path to restoring,
- (ii) identifying a plurality of adjacent nodes with required bandwidth for said virtual path,
- (iii) forwarding a path restoration request to said plurality of adjacent nodes with required bandwidth for said virtual path, and
- (iv) waiting for a response for said path restoration request for a first predetermined time interval.

18. The method of claim 17, further comprising:

if said response for said path restoration request is not receive within said first predetermined time interval, repeating steps (ii) – (iv) for a second predetermined time interval.

19. The method of claim 18, further comprising:

if said response for said path restoration request is not received with in said second predetermined time interval, generating network alarms.

20. The method of claim 19, wherein said first and said second predetermined time intervals are defined during provisioning of said virtual path.

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21. The method of claim 19, wherein said first and said second predetermined time intervals are dynamically calculated by said network based on network traffic condition.

22. The method of claim 6, wherein said restoring of said virtual path is performed by one of said intermediate nodes.

23. The method of claim 22, wherein said failure is a local physical port failure between said intermediary node and an adjacent node comprising said virtual path.

24. The method of claim 23, further comprising:
determining an available different physical port of said link
between said intermediary node and said adjacent
nodes;
initiating a physical port switch request for said adjacent node;
provisioning said virtual path to said different physical port;
and
updating said provisioning information in a node database.

25. The method of claim 24, further comprising:
if different physical port of said link between said intermediary
node and said adjacent nodes is unavailable,
a. changing a state of said virtual path to down,
b. generating a restoration request,
c. forwarding said restoration request to a plurality of
adjacent nodes comprising said virtual path, and
d. waiting for a response to said restoration request for
a predetermined interval of time.

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26. The method of claim 25, further comprising:
if said response to said restoration request is not received
within said predetermined interval of time,
repeating steps (b) – (d) for a predefined threshold
times.

27. The method of claim 26, further comprising:
if said response to said restoration request is not received
within said predefined threshold times,
releasing resources of said virtual path.

28. The method of claim 27, wherein said predetermined interval of time
and said predefined threshold are defined during provisioning of said virtual path.

29. The method of claim 27, wherein said predetermined interval of time
and said predefined threshold are dynamically calculated by said network based on
network traffic condition.

30. The method of claim 26, further comprising:
if said response to said restoration request is received,
releasing resources of said virtual path.

31. The method of claim 22, further comprising:
if said intermediary node receives a message of a remote port
failure at a node comprising said virtual path,
changing a state of said virtual path to down,
forwarding said message to a plurality of adjacent nodes
comprising said virtual path, and
initiating a timer for receiving a response to said
forwarded message.

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32. The method of claim 31, further comprising:
if said timer expires before said response to said forwarded
message is received,
releasing resources of said virtual path.

5 33. The method of claim 31, further comprising:
if said response to said forwarded message is received,
releasing resources of said virtual path.

34. The method of claim 22, further comprising:
if said intermediary node receives a valid restore path request,
10 updating path information in a node database,
allocating resources requested for said virtual path, and
forwarding said restore path request to all eligible
adjacent nodes.

35. The method of claim 22, further comprising:
15 if said intermediary node receives an invalid restore path
request,
responding with a negative acknowledgment.

36. The method of claim 6, wherein restoring of said virtual path is
performed by said second node.

20 37. The method of claim 36, further comprising:
if said failure is a local physical port failure between said
second node and an adjacent node comprising said
virtual path,
determining an available different physical port of said
25 link between said second node and said adjacent
nodes,

initiating a physical port switch request for said adjacent
node,
provisioning said virtual path to said different physical
port, and
5 updating said provisioning information in a node
database.

38. The method of claim 37, further comprising:
if different physical port of said link between said second node
and said adjacent nodes is unavailable,
10 a. changing a state of said virtual path to down,
b. generating a restoration request,
c. forwarding said restoration request to a plurality of
adjacent nodes comprising said virtual path, and
d. waiting for a response to said restoration request for
15 a predetermined interval of time.

39. The method of claim 38, further comprising:
if said response to said restoration request is not received
within said predetermined interval of time,
repeating steps (b) – (d) for a predefined threshold
20 times.

40. The method of claim 39, further comprising:
if said response to said restoration request is not received
within said predefined threshold times,
releasing resources of said virtual path.

25 41. The method of claim 40, wherein said predetermined interval of time
and said predefined threshold are defined during provisioning of said virtual path.

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42. The method of claim 40, wherein said predetermined interval of time and said predefined threshold are dynamically calculated by said network based on network traffic condition.

43. The method of claim 39, further comprising:
if said response to said restoration request is received,
releasing resources of said virtual path.

44. The method of claim 36, further comprising:
if said second node receives a message of a remote port failure
at a node comprising said virtual path,
acknowledging said message,
changing a state of said virtual path to down, and
releasing resources of said virtual path.

45. The method of claim 36, further comprising:
if said second node receives a valid restore path request,
updating path information in a node database, and
allocating resources requested for said virtual path.

46. The method of claim 36, further comprising:
if said second node receives an invalid restore path request,
responding with a negative acknowledgment.

47. A computer system comprising:
a processor;
an optical network interface, coupled to said processor and to
an optical network;
computer readable medium coupled to said processor; and
computer code, encoded in said computer readable medium,
configured to cause said processor to:
broadcast a plurality of resource request packets to a
plurality of said nodes in said optical network;

identify a plurality of nodes with resources wherein said
nodes with resources are ones of said nodes
having a resource necessary to support said
virtual path;

5 determine an alternate physical path, said alternate
physical path comprising ones of said nodes
with resources;

configure said alternate physical path by establishing a
communication connection between said ones of
10 said nodes with resources; and

restore said virtual path by provisioning said virtual
path over said alternate physical path.

48. The computer system of claim 47, wherein said computer code
configured to cause said processor to:
15 detect a failure in said virtual path.

49. The computer system of claim 47, wherein said computer code
configured to cause said processor to restore said virtual path is further configured to
cause said processor to:
complete restoration of said virtual path in less than 50
20 milliseconds.

50. The computer system of claim 47, wherein:
said virtual path is provisioned on a physical path between a
first and a second node of said optical network;
said optical network comprises said nodes; and
25 each one of said nodes is coupled to at least one another of said
nodes by a plurality of optical links.

51. The computer system of claim 50, wherein:
said physical path between said first and said second node
comprises a plurality of intermediate nodes.

52. The computer system of claim 50, wherein each one of said nodes is
5 coupled to at least one another of said nodes in a mesh topology.

53. The computer system of claim 52, wherein said computer code is
configured to cause said processor to perform said restoring of said virtual path at said
first node.

54. The computer system of claim 53, wherein said computer code
10 configured to cause said processor to:
if said failure is a local physical port failure between said first
node and an adjacent node,
determine an available different physical port of said
link between said first node and said adjacent
15 nodes,
initiate a physical port switch request for said adjacent
node,
provision said virtual path to said different physical
port, and
20 update said provisioning information in a node
database.

55. The computer system of claim 54, wherein said computer code
configured to cause said processor to:
if different physical port of said link between said first node
25 and said adjacent nodes is unavailable,
(i) change a state of said virtual path to restoring,
(ii) identify a plurality of adjacent nodes with required
bandwidth for said virtual path,

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- (iii)forward a path restoration request to said plurality of adjacent nodes with required bandwidth for said virtual path, and
- (iv)wait for a response for said path restoration request for a first predetermined time interval.

56. The computer system of claim 55, wherein said computer code configured to cause said processor to:

- if said response to said path restoration request is not received within said first predetermined time interval,
- repeat steps (ii) – (iv) for a second predetermined time interval.

57. The computer system of claim 56, wherein said computer code configured to cause said processor to:

- if said response is not received within said second predetermined time interval,
- generate network alarms.

58. The computer system of claim 53, wherein said computer code configured to cause said processor to:

- if said failure did not occur at a physical port of said link between said first node and one of adjacent nodes of said first node,
- (i) change a state of said virtual path to restoring,
- (ii) identify a plurality of adjacent nodes with required bandwidth for said virtual path,
- (iii)forward a path restoration request to said plurality of adjacent nodes with required bandwidth for said virtual path, and
- (iv)wait for a response for said path restoration request for a first predetermined time interval.

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59. The computer system of claim 58, wherein said computer code configured to cause said processor to:

if said response for said path restoration request is not receive
within said first predetermined time interval,
repeat steps (ii) – (iv) for a second predetermined time
interval.

60. The computer system of claim 59, wherein said computer code configured to cause said processor to:

if said response for said path restoration request is not received
with in said second predetermined time interval,
generate network alarms.

61. The computer system of claim 52, wherein said computer code configured to cause said processor to perform said restoring of said virtual path at one of said intermediate nodes.

62. The computer system of claim 61, wherein said computer code configured to cause said processor to:

if said failure is a local physical port failure between said
intermediary node and an adjacent node comprising said
virtual path,
determine an available different physical port of said
link between said intermediary node and said
adjacent nodes,
initiate a physical port switch request for said adjacent
node,
provision said virtual path to said different physical
port, and
update said provisioning information in a node
database.

63. The computer system of claim 62, wherein said computer code configured to cause said processor to:

if different physical port of said link between said intermediary

node and said adjacent nodes is unavailable,

a. change a state of said virtual path to down,

b. generate a restoration request,

c. forward said restoration request to a plurality of adjacent nodes comprising said virtual path, and

d. wait for a response to said restoration request for a predetermined interval of time.

64. The computer system of claim 63, wherein said computer code configured to cause said processor to:

if said response to said restoration request is not received

within said predetermined interval of time,

repeat steps (b) – (d) for a predefined threshold times.

65. The computer system of claim 64, wherein said computer code configured to cause said processor to:

if said response to said restoration request is not received

within said predefined threshold times,

release resources of said virtual path.

66. The computer system of claim 64, wherein said computer code configured to cause said processor to:

if said response to said restoration request is received,

release resources of said virtual path.

67. The computer system of claim 61, wherein said computer code configured to cause said processor to:

if said intermediary node receives a message of a remote port

failure at a node comprising said virtual path,

change a state of said virtual path to down,

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forward said message to a plurality of adjacent nodes
comprising said virtual path, and
initiate a timer for receiving a response to said
forwarded message.

5 68. The computer system of claim 67, wherein said computer code
configured to cause said processor to:
if said timer expires before said response to said forwarded
message is received,
release resources of said virtual path.

10 69. The computer system of claim 67, wherein said computer code
configured to cause said processor to:
if said response to said forwarded message is received,
release resources of said virtual path.

15 70. The computer system of claim 61, wherein said computer code
configured to cause said processor to:
if said intermediary node receives a valid restore path request,
update path information in a node database,
allocate resources requested for said virtual path, and
forward said restore path request to all eligible adjacent
20 nodes.

71. The computer system of claim 61, wherein said computer code
configured to cause said processor to:
if said intermediary node receives an invalid restore path
request,
25 respond with a negative acknowledgment.

72. The computer system of claim 52, wherein said computer code
configured to cause said processor to perform said restoring of said virtual path at said
second node.

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73. The computer system of claim 72, wherein said computer code configured to cause said processor to:

if said failure is a local physical port failure between said second node and an adjacent node comprising said virtual path,
determine an available different physical port of said link between said second node and said adjacent nodes,
initiate a physical port switch request for said adjacent node,
provision said virtual path to said different physical port, and
update said provisioning information in a node database.

74. The computer system of claim 73, wherein said computer code configured to cause said processor to:

if different physical port of said link between said second node and said adjacent nodes is unavailable,
a. change a state of said virtual path to down,
b. generate a restoration request,
c. forward said restoration request to a plurality of adjacent nodes comprising said virtual path, and
d. wait for a response to said restoration request for a predetermined interval of time.

75. The computer system of claim 72, wherein said computer code configured to cause said processor to:

if said response to said restoration request is not received within said predetermined interval of time,
repeat steps (b) + (d) for a predefined threshold times.

76. The computer system of claim 75, wherein said computer code configured to cause said processor to:

if said response to said restoration request is not received
within said predefined threshold times,
release resources of said virtual path.

77. The computer system of claim 75, wherein said computer code configured to cause said processor to:

if said response to said restoration request is received,
release resources of said virtual path.

78. The computer system of claim 72, wherein said computer code configured to cause said processor to:

if said second node receives a message of a remote port failure
at a node comprising said virtual path,
acknowledge said message,
change a state of said virtual path to down, and
release resources of said virtual path.

79. The computer system of claim 72, wherein said computer code configured to cause said processor to:

if said second node receives a valid restore path request,
update path information in a node database, and
allocate resources requested for said virtual path.

80. The computer system of claim 72, wherein said computer code configured to cause said processor to:

if said second node receives an invalid restore path request,
respond with a negative acknowledgment.

81. A computer program product encoded in computer readable media, said program product comprising:

- a first set of instructions executable on a computer system,
configured to broadcast a plurality of resource request
packets to a plurality of nodes in an optical network;
- a second set of instructions executable on said computer
system, configured to identify a plurality of nodes with
resources wherein said nodes with resources are ones of
said nodes having a resource necessary to support said
virtual path;
- a third set of instructions executable on said computer system,
configured to determine an alternate physical path, said
alternate physical path comprising ones of said nodes
with resources;
- a fourth set of instructions executable on said computer system,
configured to configure said alternate physical path by
establishing a communication connection between said
ones of said nodes with resources; and
- a fifth set of instructions executable on said computer system,
configured to restore said virtual path by provisioning
said virtual path over said alternate physical path.

82. The computer program product of claim 81, further comprising:

- a sixth set of instruction executable on said computer system,
configured to detect a failure in said virtual path in said
optical system.

83. The computer program product of claim 81, wherein said first set of instruction comprises:

- a first sub-set of instructions, executable on said computer
system, configured to receive a failure message packet;

a second sub-set of instructions, executable on said computer system, configured to analyze said failure message packet; and
a third sub-set of instructions, executable on said computer system, configured to identify if said failure is a local failure.

84. The computer program product of claim 81, wherein: said virtual path is provisioned on a physical path between a first and a second node of said optical network, said physical path comprises a plurality of intermediate nodes, each one of said nodes is coupled to at least on another of said nodes in a mesh topology.

85. The computer program product of claim 84, wherein said restoring of said virtual path is performed by said first node.

86. The computer program product of claim 85, further comprising: a sixth set of instructions executable on said computer system, configured to:
if said failure is a local physical port failure between said first node and an adjacent node,
determine an available different physical port of said link between said first node and said adjacent nodes,
initiate a physical port switch request for said adjacent node,
provision said virtual path to said different physical port, and
update said provisioning information in a node database.

87. The computer program product of claim 86, further comprising:
a seventh set of instructions executable on said computer
system, configured to:

if different physical port of said link between said first node
and said adjacent nodes is unavailable,

(i) change a state of said virtual path to restoring,

(ii) identify a plurality of adjacent nodes with required
bandwidth for said virtual path,

(iii) forward a path restoration request to said plurality of
adjacent nodes with required bandwidth for said virtual
path, and

(iv) wait for a response for said path restoration request for a
first predetermined time interval.

88. The computer program product of claim 87, further comprising:
an eighth set of instructions executable on said computer
system, configured to:

if said response to said path restoration request is not received
within said first predetermined time interval,
repeat steps (ii) – (iv) for a second predetermined time
interval.

89. The computer program product of claim 86, further comprising:
a ninth set of instructions executable on said computer system,
configured to:

if said response is not received within said second
predetermined time interval,
generate network alarms.

90. The computer program product of claim 85, further comprising:
a sixth set of instructions executable on said computer system,
configured to:

if said failure did not occur at a physical port of said link
between said first node and one of adjacent nodes of
said first node,

(i) changing a state of said virtual path to restoring,

(ii) identifying a plurality of adjacent nodes with
required bandwidth for said virtual path,

(iii) forwarding a path restoration request to said
plurality of adjacent nodes with required
bandwidth for said virtual path, and

(iv) waiting for a response for said path restoration
request for a first predetermined time interval.

91. The computer program product of claim 90, further comprising:
a seventh set of instructions executable on said computer
system, configured to:

if said response for said path restoration request is not receive
within said first predetermined time interval,
repeat steps (ii) - (iv) for a second predetermined time
interval.

92. The computer program product of claim 90, further comprising:
an eighth set of instructions executable on said computer
system, configured to:

if said response for said path restoration request is not received
with in said second predetermined time interval,
generate network alarms.

93. The computer program product of claim 84, wherein said restoring of
said virtual path is performed by one of said intermediate nodes.

94. The computer program product of claim 93, further comprising:
a sixth set of instructions executable on said computer system,
configured to:

if said failure is a local port failure between said intermediary
 node and an adjacent node comprising said virtual path,
 determine an available different physical port of said
 link between said intermediary node and said
 adjacent nodes,
 initiate a physical port switch request for said adjacent
 node,
 provision said virtual path to said different physical
 port, and
 update said provisioning information in a node database.

95. The computer program product of claim 94, further comprising:
 a seventh set of instructions executable on said computer
 system, configured to:

if different physical port of said link between said intermediary
 node and said adjacent nodes is unavailable,
 a. change a state of said virtual path to down,
 b. generate a restoration request,
 c. forward said restoration request to a plurality of
 adjacent nodes comprising said virtual path, and
 d. wait for a response to said restoration request for a
 predetermined interval of time.

96. The computer program product of claim 95, further comprising:
 an eighth set of instructions executable on said computer
 system, configured to:

if said response to said restoration request is not received
 within said predetermined interval of time,
 repeat steps (b) – (d) for a predefined threshold times.

97. The computer program product of claim 96, further comprising:
 a ninth set of instructions executable on said computer system,
 configured to:

if said response to said restoration request is not received
within said predefined threshold times,
release resources of said virtual path.

98. The computer program product of claim 97, further comprising:
a tenth set of instructions executable on said computer system,
configured to:
if said response to said restoration request is received,
release resources of said virtual path.

99. The computer program product of claim 93, further comprising:
a sixth set of instructions executable on said computer system,
configured to:
if said intermediary node receives a message of a remote port
failure at a node comprising said virtual path,
change a state of said virtual path to down,
forward said message to a plurality of adjacent nodes
comprising said virtual path, and
initiate a timer for receiving a response to said
forwarded message.

100. The computer program product of claim 99, further comprising:
a seventh set of instructions executable on said computer
system, configured to:
if said timer expires before said response to said forwarded
message is received,
release resources of said virtual path.

101. The computer program product of claim 100, further comprising:
an eighth set of instructions executable on said computer
system, configured to:
if said response to said forwarded message is received,
release resources of said virtual path.

102. The computer program product of claim 93, further comprising:
a sixth set of instructions executable on said computer system,
configured to:
if said intermediary node receives a valid restore path request,
updating path information in a node database,
allocating resources requested for said virtual path, and
forwarding said restore path request to all eligible
adjacent nodes.

103. The computer program product of claim 93, further comprising:
a sixth set of instructions executable on said computer system,
configured to:
if said intermediary node receives an invalid restore path
request,
respond with a negative acknowledgment.

104. The computer program product of claim 84, wherein said restoring of
said virtual path is performed by said second node.

105. The computer program product of claim 104, further comprising:
a sixth set of instructions executable on said computer system,
configured to:
if said failure is a local physical port failure between said
second node and an adjacent node comprising said
virtual path,
determine an available different physical port of said
link between said second node and said adjacent
nodes,
initiate a physical port switch request for said adjacent
node,
provision said virtual path to said different physical
port, and

106. The computer program product of claim 105, further comprising:
a seventh set of instructions executable on said computer

if different physical port of said link between said second node and said adjacent nodes is unavailable,

107. The computer program product of claim 106, further comprising:
an eighth set of instructions executable on said computer

if said response to said restoration request is not received
within said predetermined interval of time,
repeat steps (b) – (d) for a predefined threshold times.

if said response to said restoration request is not received
within said predefined threshold times,
release resources of said virtual path.

configured to:

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110. The computer program product of claim 104, further comprising:
a sixth set of instructions executable on said computer system,
configured to:

if said second node receives a message of a remote port failure
at a node comprising said virtual path,
acknowledge said message,
change a state of said virtual path to down, and
release resources of said virtual path.

111. The computer program product of claim 104, further comprising:
a sixth set of instructions executable on said computer system,
configured to:

if said second node receives a valid restore path request,
update path information in a node database, and
allocate resources requested for said virtual path.

112. The computer program product of claim 104, further comprising:
a sixth set of instructions executable on said computer system,
configured to:

if said second node receives an invalid restore path request,
respond with a negative acknowledgment.

113. A computer system comprising:

means for broadcasting a plurality of resource request packets
to a plurality of nodes in an optical network;

means for identifying a plurality of nodes with resources
wherein said nodes with resources are ones of said
nodes having a resource necessary to support a virtual
path;

means for determining an alternate physical path, said alternate
physical path comprising ones of said nodes with
resources;

means for configuring said alternate physical path by
 establishing a communication connection between said
 ones of said nodes with resources; and
 means for restoring said virtual path by provisioning said
 virtual path over said alternate physical path.

114. The computer system of claim 113, further comprising:
 means for detecting a failure in said virtual path by receiving a
 failure message.

115. The computer system of claim 114, further comprising:
 means for receiving a failure message packet;
 means for acknowledging said failure message packet; and
 means for determining said nodes with resources is done by
 analyzing a response to said resource request packets.

116. The computer system of claim 114, wherein:
 said virtual path is provisioned on a physical path between a
 first and a second node of said optical network;
 said physical path between said first and said second node
 comprises a plurality of intermediate nodes;
 said optical network comprises said nodes; and
 each one of said nodes is coupled to at least one another of said
 nodes by a plurality of optical links.

117. The computer system of claim 116, wherein each one of said nodes is
 coupled to at least one another of said nodes in a mesh topology.

118. The computer system of claim 117, wherein said means for restoring of
 said virtual path by is included in said first node.

119. The computer system of claim 118, further comprising:
means, if said failure is a local physical port failure between
said first node and an adjacent node, for
determining an available different physical port of said
link between said first node and said adjacent
nodes,
initiating a physical port switch request for said adjacent
node,
provisioning said virtual path to said different physical
port, and
updating said provisioning information in a node
database.

120. The computer system of claim 119, further comprising:
means, if different physical port of said link between said first
node and said adjacent nodes is unavailable, for
(i) changing a state of said virtual path to restoring,
(ii) identifying a plurality of adjacent nodes with
required bandwidth for said virtual path,
(iii) forwarding a path restoration request to said
plurality of adjacent nodes with required
bandwidth for said virtual path, and
(iv) waiting for a response for said path restoration
request for a first predetermined time interval.

121. The computer system of claim 120, further comprising:
if said response to said path restoration request is not received
within said first predetermined time interval,
means for repeating steps (ii) – (iv) for a second
predetermined time interval.

122. The computer system of claim 121, further comprising:
means, if said response is not receive in within said second
predetermined time interval, for
generating network alarms.

5 123. The computer system of claim 119, further comprising:
means, if said failure did not occur at a physical port of said
link between said first node and one of adjacent nodes
of said first node, for
10 (i) changing a state of said virtual path to restoring,
(ii) identifying a plurality of adjacent nodes with
required bandwidth for said virtual path,
(iii) forwarding a path restoration request to said
plurality of adjacent nodes with required
bandwidth for said virtual path, and
15 (iv) waiting for a response for said path restoration
request for a first predetermined time interval.

124. The computer system of claim 123, further comprising:
if said response for said path restoration request is not receive
within said first predetermined time interval,
20 means for repeating steps (ii) – (iv) for a second
predetermined time interval.

125. The computer system of claim 124, further comprising:
means, if said response for said path restoration request is not
received with in said second predetermined time
25 interval, for
generating network alarms.

126. The computer system of claim 117, wherein said restoring of said
virtual path is performed by one of said intermediate nodes.

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127. The computer system of claim 126, further comprising:
means, if said failure is a local physical port failure between
said intermediary node and an adjacent node comprising
said virtual path, for
5 determining an available different physical port of said
link between said intermediary node and said
adjacent nodes,
initiating a physical port switch request for said adjacent
node,
10 provisioning said virtual path to said different physical
port, and
updating said provisioning information in a node
database.

128. The computer system of claim 127, further comprising:
means, if different physical port of said link between said
intermediary node and said adjacent nodes is
unavailable, for
15 a. changing a state of said virtual path to down,
b. generating a restoration request,
20 c. forwarding said restoration request to a plurality of
adjacent nodes comprising said virtual path, and
d. waiting for a response to said restoration request for
a predetermined interval of time.

129. The computer system of claim 128, further comprising:
means, if said response to said restoration request is not
25 received within said predetermined interval of time, for
repeating steps (b) – (d) for a predefined threshold
times.

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130. The computer system of claim 129, further comprising:
means, if said response to said restoration request is not
received within said predefined threshold times, for
releasing resources of said virtual path.

5 131. The computer system of claim 129, further comprising:
means, if said response to said restoration request is received,
for
releasing resources of said virtual path.

10 132. The computer system of claim 126, further comprising:
means, if said intermediary node receives a message of a
remote port failure at a node comprising said virtual
path, for
changing a state of said virtual path to down,
forwarding said message to a plurality of adjacent nodes
15 comprising said virtual path, and
initiating a timer for receiving a response to said
forwarded message.

20 133. The computer system of claim 132, further comprising:
means, if said timer expires before said response to said
forwarded message is received, for
releasing resources of said virtual path.

134. The computer system of claim 132, further comprising:
means, if said response to said forwarded message is received,
releasing resources of said virtual path.

135. The computer system of claim 126, further comprising:
means, if said intermediary node receives a valid restore path
request, for
updating path information in a node database,
allocating resources requested for said virtual path, and
forwarding said restore path request to all eligible
adjacent nodes.

136. The method of claim 126, further comprising:
means, if said intermediary node receives an invalid restore
path request, for
responding with a negative acknowledgment.

137. The computer system of claim 117, wherein means for restoring of said
virtual path is included in said second node.

138. The computer system of claim 137, further comprising:
means, if said failure is a local physical port failure between
said second node and an adjacent node comprising said
virtual path, for
determining an available different physical port of said
link between said second node and said adjacent
nodes,
initiating a physical port switch request for said adjacent
node,
provisioning said virtual path to said different physical
port, and
updating said provisioning information in a node
database.

139. The computer system of claim 138, further comprising:
means, if different physical port of said link between said
second node and said adjacent nodes is unavailable, for

- a. changing a state of said virtual path to down,
- b. generating a restoration request,
- c. forwarding said restoration request to a plurality of adjacent nodes comprising said virtual path, and
- d. waiting for a response to said restoration request for a predetermined interval of time.

140. The computer system of claim 139, further comprising: means, if said response to said restoration request is not received within said predetermined interval of time, for repeating steps (b) – (d) for a predefined threshold times.

141. The computer system of claim 140, further comprising: means, if said response to said restoration request is not received within said predefined threshold times, for releasing resources of said virtual path.

142. The computer system of claim 140, further comprising: means, if said response to said restoration request is received, for releasing resources of said virtual path.

143. The computer system of claim 137, further comprising: means, if said second node receives a message of a remote port failure at a node comprising said virtual path, for acknowledging said message, changing a state of said virtual path to down, and releasing resources of said virtual path.

144. The computer system of claim 137, further comprising: means, if said second node receives a valid restore path request, updating path information in a node database, and allocating resources requested for said virtual path.

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Parameter	Value	Unit
Mean age	21.5	years
Mean height	1.75	m
Mean weight	65.0	kg
Mean BMI	21.5	kg/m ²
Mean waist circumference	85.0	cm
Mean hip circumference	105.0	cm
Mean waist-hip ratio	0.81	
Mean systolic blood pressure	115.0	mmHg
Mean diastolic blood pressure	75.0	mmHg
Mean heart rate	75.0	beats/min
Mean resting energy expenditure	1800.0	kcal/day
Mean total energy expenditure	2500.0	kcal/day
Mean physical activity level	1.5	
Mean fat mass	15.0	kg
Mean lean mass	50.0	kg
Mean bone mass	2.5	kg
Mean bone mineral density	1.0	g/cm ³
Mean bone mineral content	10.0	g
Mean bone mineral density T-score	-1.0	
Mean bone mineral density Z-score	-0.5	
Mean bone mineral density SD	0.2	
Mean bone mineral density SE	0.05	
Mean bone mineral density CI	0.1	
Mean bone mineral density P-value	0.05	
Mean bone mineral density R ²	0.1	
Mean bone mineral density F	1.0	
Mean bone mineral density S	0.0	
Mean bone mineral density T	0.0	
Mean bone mineral density U	0.0	
Mean bone mineral density V	0.0	
Mean bone mineral density W	0.0	
Mean bone mineral density X	0.0	
Mean bone mineral density Y	0.0	
Mean bone mineral density Z	0.0	
Mean bone mineral density AA	0.0	
Mean bone mineral density AB	0.0	
Mean bone mineral density AC	0.0	
Mean bone mineral density AD	0.0	
Mean bone mineral density AE	0.0	
Mean bone mineral density AF	0.0	
Mean bone mineral density AG	0.0	
Mean bone mineral density AH	0.0	
Mean bone mineral density AI	0.0	
Mean bone mineral density AJ	0.0	
Mean bone mineral density AK	0.0	
Mean bone mineral density AL	0.0	
Mean bone mineral density AM	0.0	
Mean bone mineral density AN	0.0	
Mean bone mineral density AO	0.0	
Mean bone mineral density AP	0.0	
Mean bone mineral density AQ	0.0	
Mean bone mineral density AR	0.0	
Mean bone mineral density AS	0.0	
Mean bone mineral density AT	0.0	
Mean bone mineral density AU	0.0	
Mean bone mineral density AV	0.0	
Mean bone mineral density AW	0.0	
Mean bone mineral density AX	0.0	
Mean bone mineral density AY	0.0	
Mean bone mineral density AZ	0.0	
Mean bone mineral density BA	0.0	
Mean bone mineral density BB	0.0	
Mean bone mineral density BC	0.0	
Mean bone mineral density BD	0.0	
Mean bone mineral density BE	0.0	
Mean bone mineral density BF	0.0	
Mean bone mineral density BG	0.0	
Mean bone mineral density BH	0.0	
Mean bone mineral density BI	0.0	
Mean bone mineral density BJ	0.0	
Mean bone mineral density BK	0.0	
Mean bone mineral density BL	0.0	
Mean bone mineral density BM	0.0	
Mean bone mineral density BN	0.0	
Mean bone mineral density BO	0.0	
Mean bone mineral density BP	0.0	
Mean bone mineral density BQ	0.0	
Mean bone mineral density BR	0.0	
Mean bone mineral density BS	0.0	
Mean bone mineral density BT	0.0	
Mean bone mineral density BU	0.0	
Mean bone mineral density BV	0.0	
Mean bone mineral density BW	0.0	
Mean bone mineral density BX	0.0	
Mean bone mineral density BY	0.0	
Mean bone mineral density BZ	0.0	
Mean bone mineral density CA	0.0	
Mean bone mineral density CB	0.0	
Mean bone mineral density CC	0.0	
Mean bone mineral density CD	0.0	
Mean bone mineral density CE	0.0	
Mean bone mineral density CF	0.0	
Mean bone mineral density CG	0.0	
Mean bone mineral density CH	0.0	
Mean bone mineral density CI	0.0	
Mean bone mineral density CJ	0.0	
Mean bone mineral density CK	0.0	
Mean bone mineral density CL	0.0	
Mean bone mineral density CM	0.0	
Mean bone mineral density CN	0.0	
Mean bone mineral density CO	0.0	
Mean bone mineral density CP	0.0	
Mean bone mineral density CQ	0.0	
Mean bone mineral density CR	0.0	
Mean bone mineral density CS	0.0	
Mean bone mineral density CT	0.0	
Mean bone mineral density CU	0.0	
Mean bone mineral density CV	0.0	
Mean bone mineral density CW	0.0	
Mean bone mineral density CX	0.0	
Mean bone mineral density CY	0.0	
Mean bone mineral density CZ	0.0	
Mean bone mineral density DA	0.0	
Mean bone mineral density DB	0.0	
Mean bone mineral density DC	0.0	
Mean bone mineral density DD	0.0	
Mean bone mineral density DE	0.0	
Mean bone mineral density DF	0.0	
Mean bone mineral density DG	0.0	
Mean bone mineral density DH	0.0	
Mean bone mineral density DI	0.0	
Mean bone mineral density DJ	0.0	
Mean bone mineral density DK	0.0	
Mean bone mineral density DL	0.0	
Mean bone mineral density DM	0.0	